

Project: I-70 Vail Pass Various Wall Repairs

Project Sub Acct. No: 21897

Date: November 1, 2018

Technical Requirements

Section 12 – Hydraulics

General

The Project shall include all Work for the modification of existing drainage facilities, construction of new drainage facilities, to meet the requirements of this section 12 and all other applicable permits and standards as included in the Contract Documents to provide adequate drainage for this Project. The project shall be designed to accommodate the design flows and to meet project design criteria. The drainage improvements shall include the improvements described in the Area Specific Drainage Requirements. For all other areas, existing drainage patterns should be maintained.

This project is not located within a FEMA floodplain.

The drainage design requirements for all proposed and existing structures shall be in accordance with the CDOT Drainage Design Manual.

The Contractor shall design drainage facilities to be compatible with existing or proposed drainage systems on adjacent properties and shall maintain existing drainage patterns.

Type 8 Repair

This type of repair includes grading to repair culvert erosion and slope protection.

In the existing condition, runoff from I-70 travels down the slope and over the top of the wall.

The drainage design meeting the requirements of this sections shall include stabilizing the slope in between the wall and I-70 and capturing these flows upstream of the wall and safely convey the flows to the toe of the slope.

Type 9 Repair

This type of repair includes grading the median to drain and installing erosion control features to stabilize the channel.

In the existing condition, median runoff from I-70 and the median was conveyed along the face of the wall causing deterioration. A temporary concrete barrier was placed at the face of the wall to minimize any further deterioration.

A drainage system meeting the requirements of this section shall be designed to capture and convey the flows away from the wall and to the toe of the slope downstream of the wall.

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Stormwater Permits

The Contractor shall be cognizant of and adhere to the requirements of the various environmental and stormwater permits that will be necessary for construction and operation of this Project. Fines may be incurred upon the project for permit non-compliance by CDOT or other regulatory agencies. Any non-compliance fines shall be passed onto the Contractor. See Section 5 – Environmental for more information.

Coordination with Other Agencies and Disciplines

The Contractor shall coordinate all water resource issues with affected regulatory agencies, where appropriate. The Contractor shall include CDOT in all meetings with the water resource regulatory agencies.

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Hydrology

The contractor shall perform hydrologic analyses for all on-site and off-site basins tributary to the proposed improvements. Hydrology calculations shall be in accordance with CDOT Drainage Design Manual for all on-site and off-site basin tributary to the project. The design storm shall be the 10-year event and the major event should be the 100-year event.

Hydraulic Design Requirements

Drainage Design Software

The following software (most recent versions) may be used in performing drainage design calculations.

1. USACE, HEC-RAS
2. FHWA, HY-8
3. Haestad Methods, StormCAD
4. Haestad Methods, Flow Master
5. Haestad Methods, Culvert Master
6. EMS-I, WMS
7. Inroads Storm and Sanitary

Data Collection

The Contractor shall be responsible for all additional mapping and surveys necessary to meet the Contract Requirements. The contractor shall be responsible for verifying utility locations and avoiding or relocating utilities due to design of drainage facilities.

The Contractor shall design drainage facilities compatible with existing or proposed drainage systems on adjacent properties, and shall preserve existing drainage patterns wherever possible. If existing drainage patterns must be changed due to design of the Project, the Contractor shall design and construct a solution that does not adversely impact property owners outside the ROW. The contractor's hydraulics design approach shall meet CDOT and FHWA requirements.

General

Roadway component geometric configurations shall be designed to provide adequate drainage and minimize hydroplaning, icing, and maintenance problems. This includes taking concentrated flows to the bottom of slopes and designing drainage systems to convey flows around walls and not allowing flows to frequently overtop the walls.

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Ditches

The roadway ditch design shall minimize erosion risk with the appropriate design and erosion control measures. The capacity and lining design shall be in accordance with HEC-15 for flexible ditch linings. Ditches shall be designed to convey the design event with a freeboard of 0.5' from overtopping banks, walls, or encroaching on the roadway and must be designed to convey the 100-year event with no overtopping of banks, walls, or encroaching on the roadway.

Storm sewer/Culverts

The storm sewer and culverts should be designed to convey the design storm in accordance with CDOT Drainage Design manual. Culverts should be designed to convey the 100-year flows and the headwater to depth ratios should be limited to the following:

1. Non-damaging to upstream or adjacent property.
2. Below the outside edge of roadway shoulder elevation
3. Headwater to depth ratio requirements shall be as shown in the CDOT Drainage Design Manual, Table 9.3
4. No overflow over walls or to other drainage basins is allowed.

The minimum pipe size for all storm sewer can culverts shall be 24-inches in diameter. Storm drains shall not decrease in size in the downstream direction. All bends or turns shall occur within a manhole. The HGL shall be at least one foot below the rims of any inlets or manholes in the 10-year event and must be below ground for the 100-year event.

The flow velocity of storm drains shall not be less than 3 feet per second for the 10-year event frequency peak discharge and not greater than 22 feet per second for the 100-year frequency peak discharge.

Culverts and storm drain outfalls shall be designed such that the outlet elevation is as close as possible to the receiving drainageway flowline to prevent erosion. Permanent erosion protection shall be provided at all outfalls and along the drainage flowlines where needed. Energy dissipaters shall be designed in accordance with FHWA HEC-14 Hydraulic design of Energy Dissipaters for Culverts and Channels.

Geotextile (Erosion Control Class 1) shall be used under all riprap per CDOT M & S Standards.

Pipe Material Selection

Drainage pipes shall have water tight joints and comply with the current CDOT Pipe Material Selection Policy. If the pipe is part of a storm sewer system with concrete manholes and inlets, then concrete pipe shall be used for uniformity of material.

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Deliverables:

Hydraulic Memorandum

The Hydraulic Memorandum (or addenda to previously Accepted reports), shall be prepared by the Contractor and submitted for acceptance prior to Final Project Acceptance. The Hydraulic Memorandum shall include references to relevant design criteria, circumstances influencing design, discussion of all drainage issues and drainage facilities, detailed design calculations, computer printouts, and appropriate maps and plans. The drainage memorandum is only required to include specific areas where drainage modifications are required. The drainage memorandum shall be sealed by a Colorado Licensed Professional Engineer, and one copy shall be submitted to the CDOT Project Engineer for Acceptance.

At a minimum, the Contractor shall submit the following to the CDOT Project Engineer for review, approval and/or acceptance:

Drainage Design Deliverables

The Contractor shall prepare plans for all drainage related facilities for the Project in a format that follows the documentation procedure in chapter 4 of the *CDOT Drainage Design Manual*, and the *CDOT CADD Manual* and *CDOT Drafting Manual*. The Contractor shall submit all applicable plans with each drainage memorandum. All deliverables shall follow the Quality Management Plan for the Project as described in Book 2, Section 3, Quality Management. The Contractor shall include the following for all drainage plan deliverables:

Deliverable	Acceptance or Approval	Schedule
Hydraulic Memo	Acceptance	Prior to Construction
Pipe Selection Report	Acceptance	Prior to Construction
Drainage Plans, Profiles and Details	Acceptance	Prior to RFC

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Plan View

1. Provide the location of all existing and proposed Storm Drains and ditches. Provide a label for each proposed Storm Drain and ditch location. The Contractor shall establish a labeling system that is specific to each proposed Storm Drain and ditch system and provide a table to summarize all pertinent information. The table shall include at a minimum the Drain Line and Sheet Number where the profile can be found.
2. Provide the location of all existing and proposed inlets, manholes, ditches, end sections, and outlet protection. Provide a label for each proposed inlet, manhole, end section, ditch, outlet Structure and outlet protection. Include a table that summarizes all pertinent information. The table shall include, at a minimum, the Label ID, Station & Offset, Item, Length, Pay Depth, and Notes.
3. Provide all existing and proposed grading.
4. Provide all Utility locations.
5. Provide location of ROW lines.

PROFILES

1. Provide profiles for all proposed Storm Drains and ditch locations. Include the Label ID from plan view sheets, station and offset, invert elevations, rim elevations, Structure depth, slopes, sizes, material, utility crossings, lining types and heights, existing and proposed finished grade lines, the design flow for the 10-year and 100-year event, and the calculated HGL for the 10-year and 100-year event.

DRAINAGE DETAILS

1. Include details for all non-standard CDOT items.
2. Include ditch typical sections.